Parametric life cycle assessment of a reusable brick veneer

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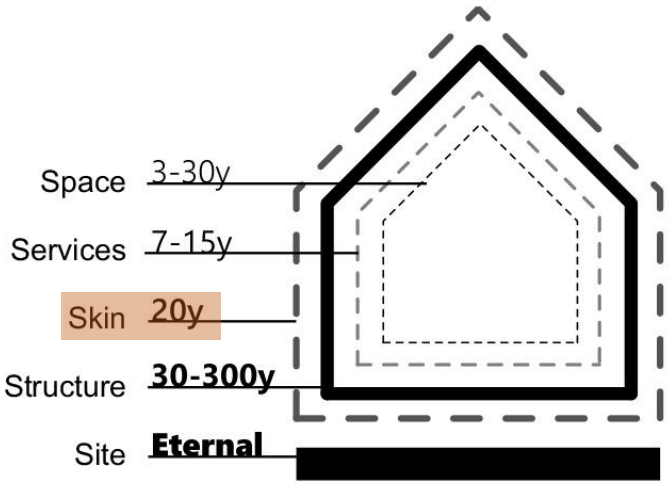
"A sustainable building is not one that must last forever, but one that can easily adapt to change."

Peter Graham, Environment Design Guide, 2006,
Royal Institute of Australian Architects

conventional brick veneer

reusable brick veneer

Reusing façade bricks is relevant because of their long technical lifespan



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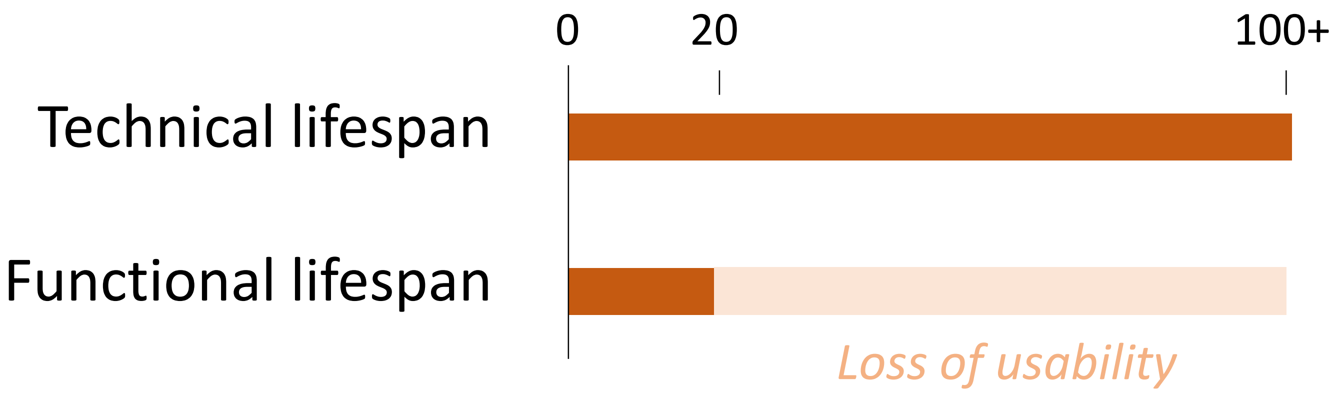


LCA

Goal & scope

Life cycle inventory

Life cycle impact assessment

Interpretation of the results

Functional unit (FU)

"a brick veneer, covering one square-meter of external wall with a self-bearing system, including anchors to the load-bearing structure, for 80 years".

Similar aesthetical, structural (self-bearing) and thermal performances, rain barrier.

System boundary

Stages A1-C4
End-of-life allocation approach: EoL recyclability 0:100 with credit for avoided virgin production

Reusable brick

180 kg hollow bricks
7 kg plastic inserts
8 steel anchors
Reusability (R): 95 %
Reusable up to 5 times

Brick & mortar

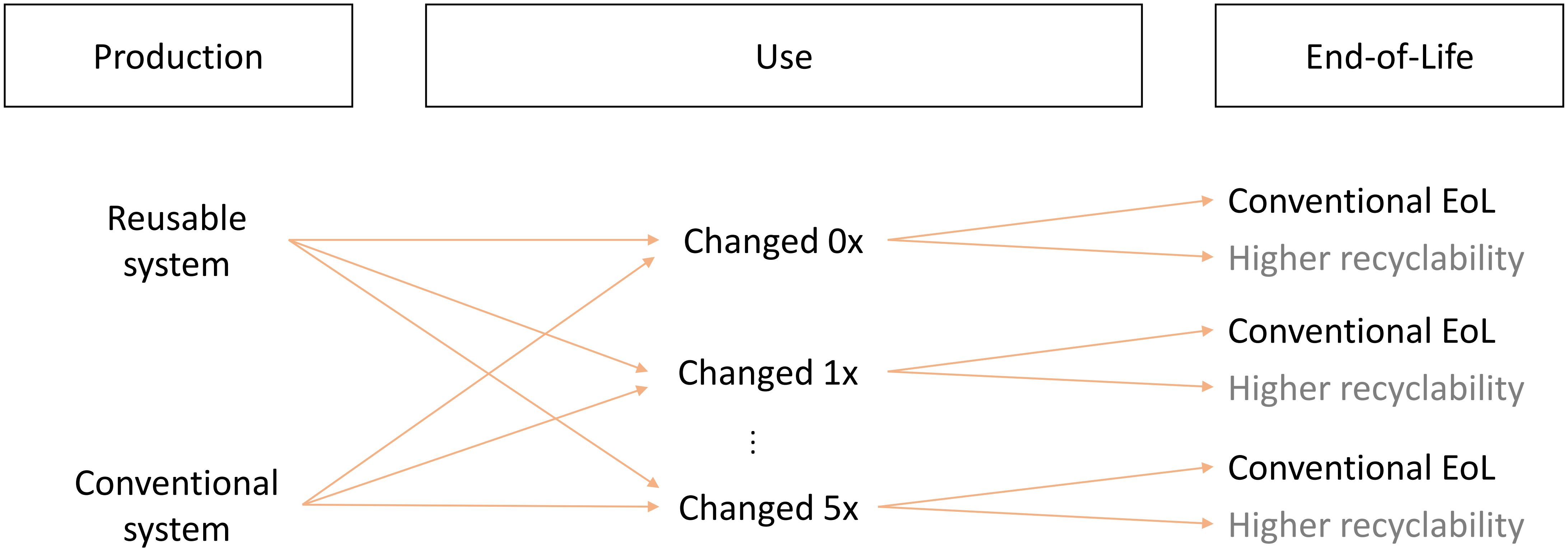
127 kg hollow bricks
48 kg mortar
5 steel anchors
Reusability (R): 0 %

Ecoinvent database

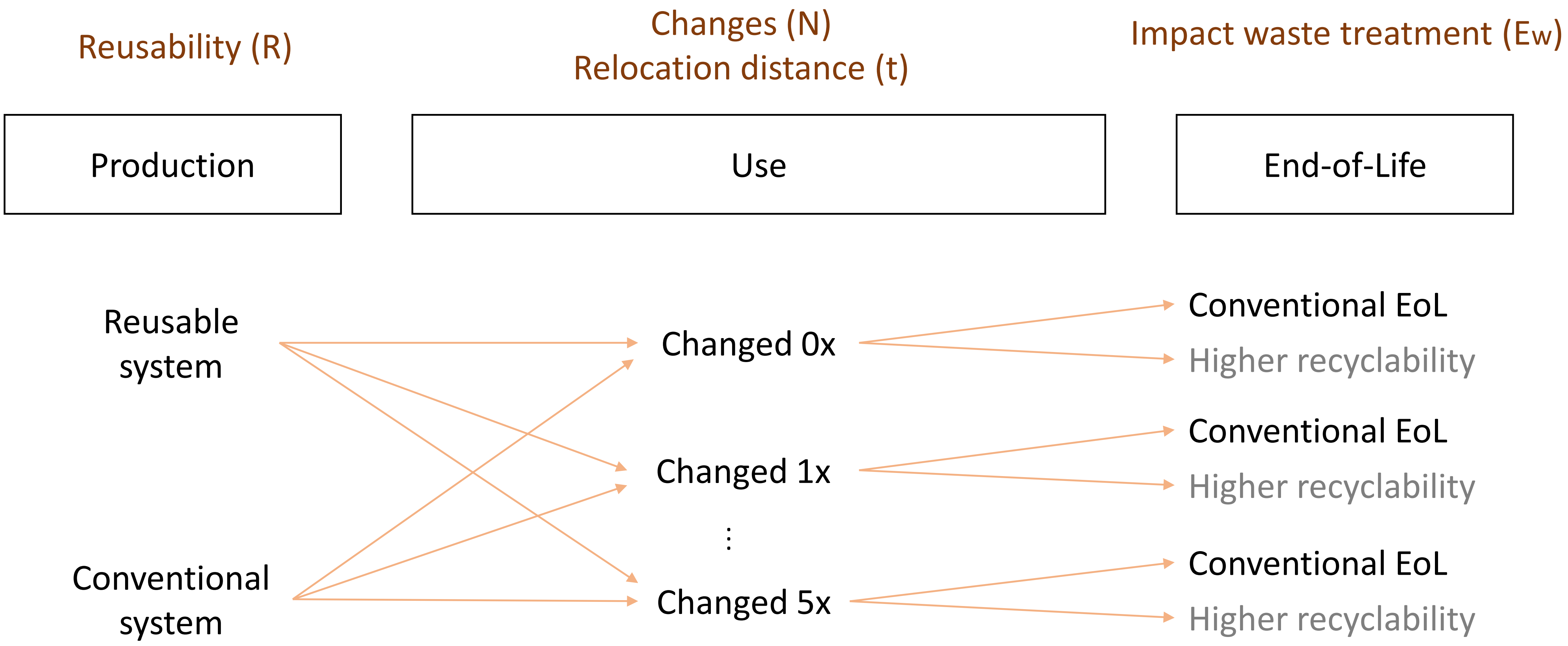
Excluded processes

Packaging of the products
Recycled content of the inserts
Demolition process (i.e. emissions and machine use)

LCA – use scenarios



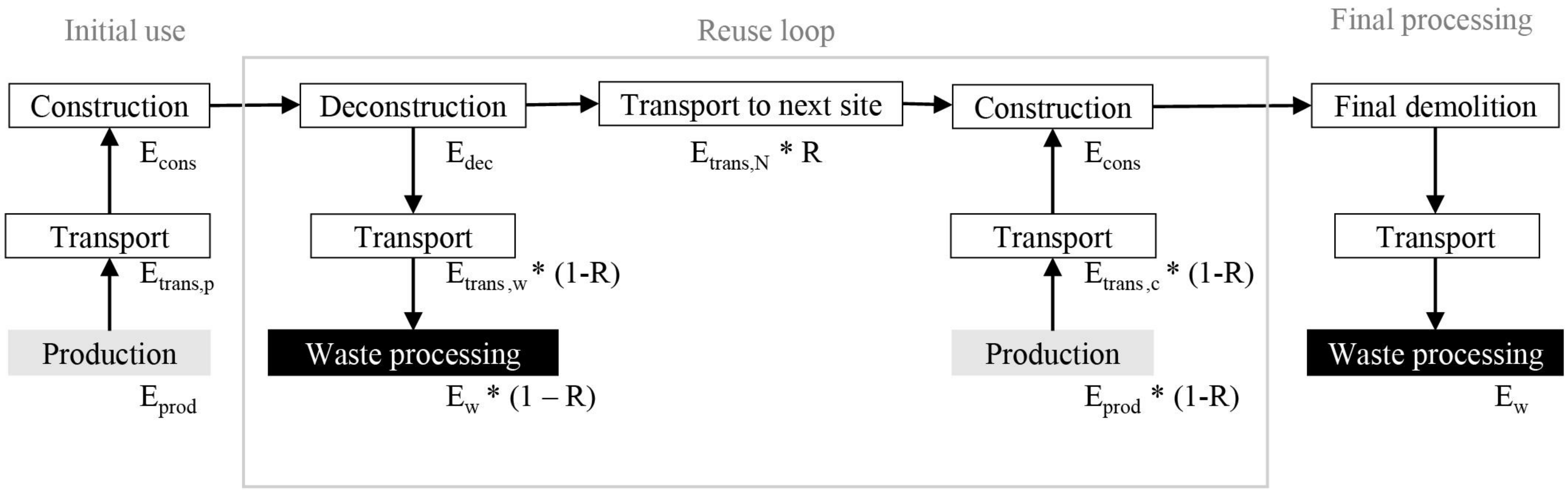
LCA – use scenarios & parametrization



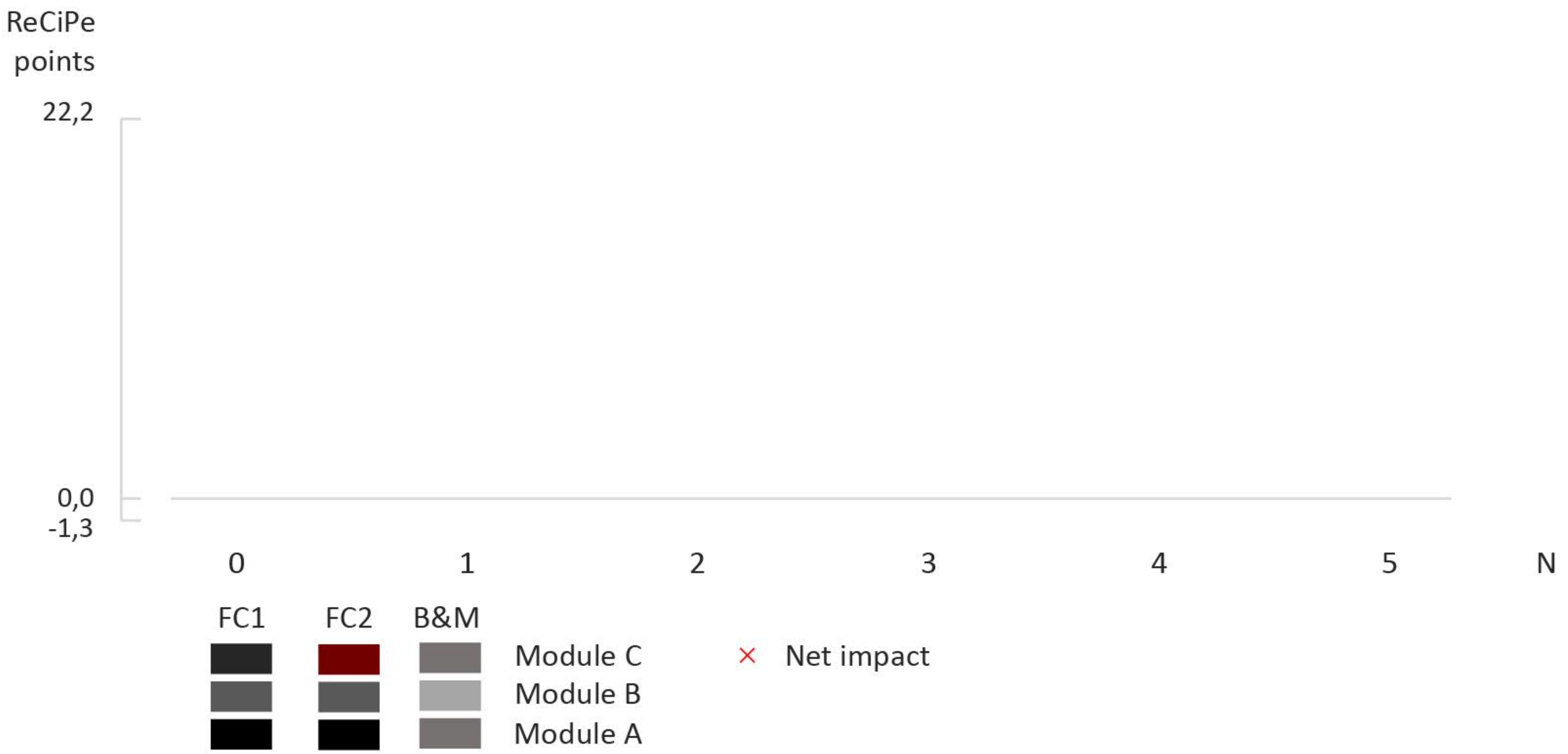
LCA – use scenarios & parametrization

$$E = E_{prod} + E_{trans,c} + E_{cons} + \quad \boldsymbol{N} \times E_N \quad + E_{decon} + E_{trans,w} + E_{waste}$$

$$E_N = E_{decon} + E_{cons} + E_{trans,N} \times \boldsymbol{R} + \left(E_{prod} + E_{trans,c} + E_{trans,w} + E_{waste}\right) \times (1 - \boldsymbol{R})$$

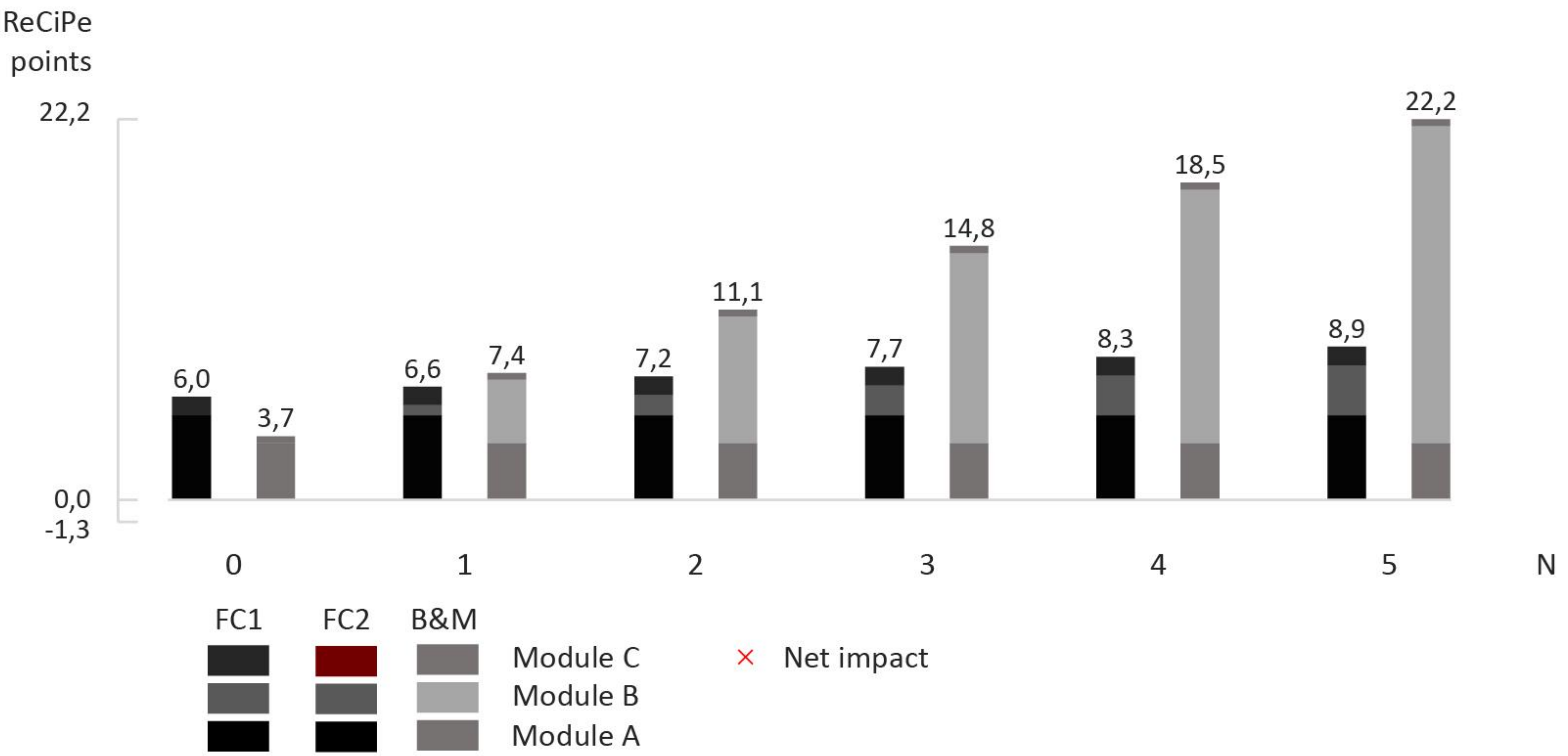


LCA – results



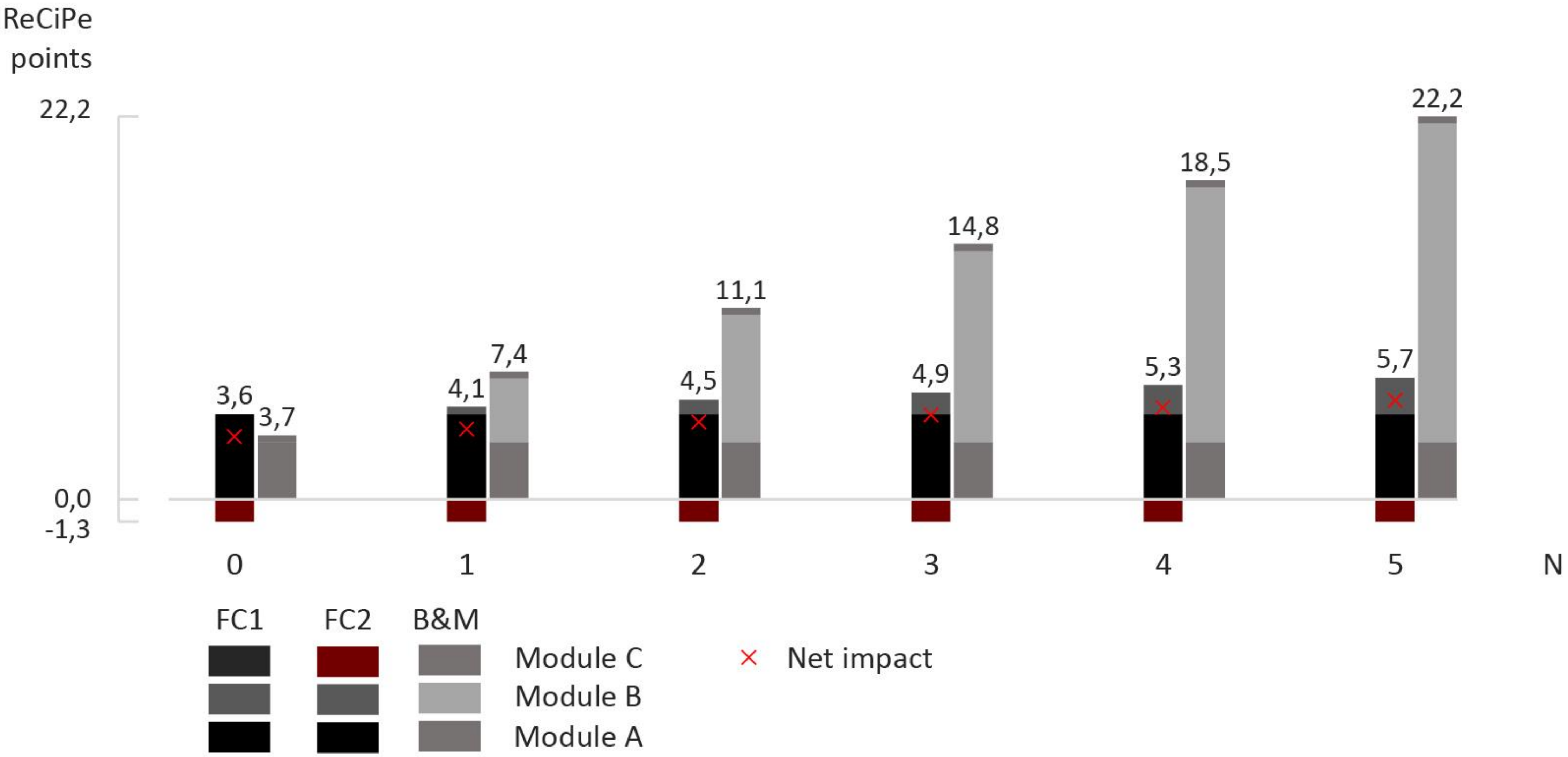
LCA single score calculation with ReCiPe Endpoint (H) V1.12 / Europe ReCiPe H/A and Ecoinvent v3. Unit: Points

LCA – results (conventional recycling rates)



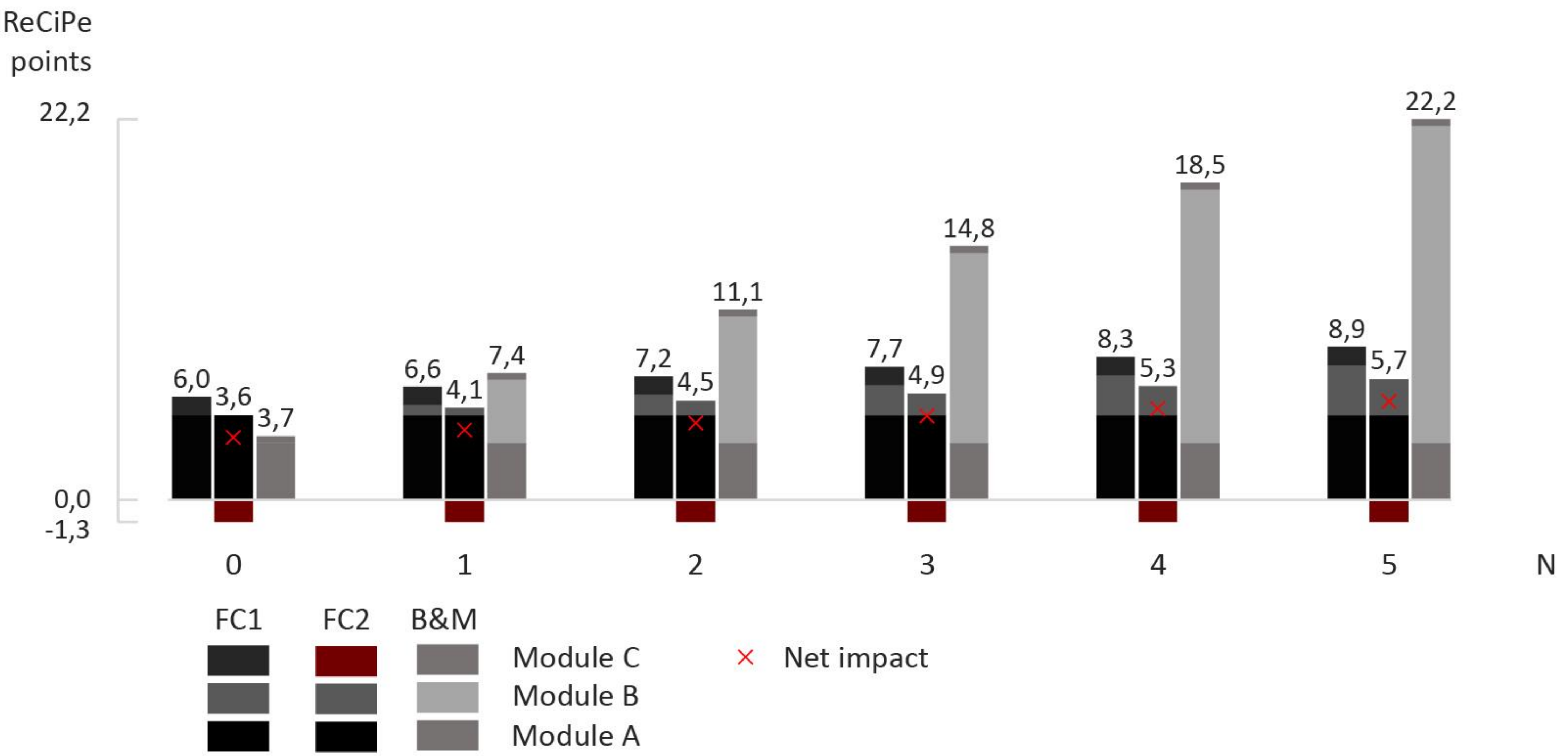
LCA single score calculation with ReCiPe Endpoint (H) V1.12 / Europe ReCiPe H/A and Ecoinvent v3. Unit: Points

LCA – results (improved recycling rates)



LCA single score calculation with ReCiPe Endpoint (H) V1.12 / Europe ReCiPe H/A and Ecoinvent v3. Unit: Points

LCA – results



LCA single score calculation with ReCiPe Endpoint (H) V1.12 / Europe ReCiPe H/A and Ecoinvent v3. Unit: Points

The reusable brick product has a **lower life cycle environmental impact** than the conventional system, when the bricks are **reused at least once**.

The environmental impact of the reusable brick product is **less sensitive to building alterations** (N) than the conventional system. The reusable system is thus more **resilient**.

The environmental impact of reusable products can be evaluated with life cycle assessment, but defining adequate use scenarios is challenging (e.g. rebound effect).

The parametric **life cycle inventory** can be refined, differentiating the reusability (R) of the sub-systems (bricks, plastic inserts and anchors).

Different allocation approaches (0:100, 100:0, 50:50, etc.) can be compared.

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